LASER TYPESETTING - TEXT AND PICTURES.

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Abstract: The Monotype Lasercomp is a high resolution raster scan typesetter. The raster scan technique provides great flexibility, permitting text and graphics to be produced at high speed. The operation of the machine is examined and the advantages of laser raster scan technology over conventional CRT techniques are discussed. The latest developments are reviewed and applications involving the production of complete pages combining text and graphics are described.

Introduction

Essentially a laser typesetter consists of a laser recording device and a computer system to control this to generate the desired image on the recording medium (Fig 1). The recording device is basically the same as a facsimile receiver. The computer system accepts input from a host (front end) system in some form of typesetter command language. It processes these commands and using its digitized character shape

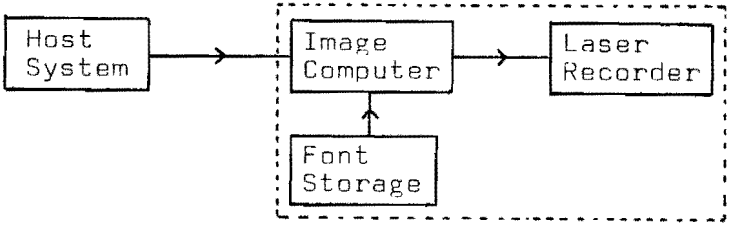


Fig 1 Typesetter block diagram

Monotype International

information, generates or synthesizes a facsimile like signal to control the recorder. Since most laser output devices operate on a raster scan principle the term Raster Image Processor is now commonly used to describe such computer systems.

The Output Unit

The Monotype Lasercomp uses a flat field laser scanning system to expose photographic film or paper. Fig 2 shows a schematic of the output unit.

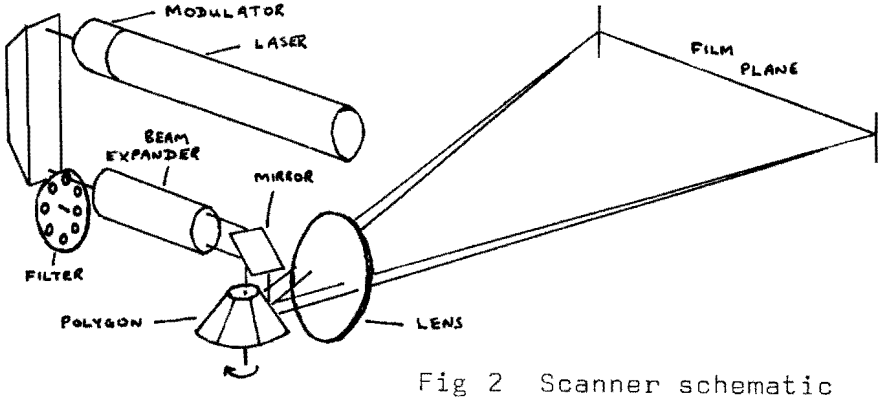


Fig 2 Scanner schematic

A 6mw Helium Neon laser is used giving very high reliability and low operating and replacement costs. The laser beam is modulated by an accousto-optic modulator which operates by deflecting the beam through an aperture into the rest of the optical system. The beam diameter is increased in the beam expander and the beam is then deflected onto a rotating pyramidal mirror (the 'Polygon'). The beam is then focussed by the lens onto the film plane. As the polygon rotates so the focussed beam traverses the width of the film plane. The lens is a proprietary design which provides a flat field and also linearizes the movement of the focussed beam so that as the polygon spins at a constant angular speed so the beam

scans across the film at a constant linear speed. The output unit provides feedback of the scanning beam's position using a photocell to detect the start of scan and a grating on the polygon shaft.

As the beam is scanned across the film so the film is advanced using a stepper motor drive. Thus the laser can build up an image a scan line at a time in what is known as a raster.

The interface between the output unit and the computer system consists fundamentally of a start of line signal and a clock signal from the output unit, and a video signal and film feed signal from the computer.

Two versions of the output unit are made - one with a five faceted polygon and one with eight facets. The basic performance parameters of these units are as follows.

Polygon facets	5	8
Width of scan (pica)	100/108	68
Resolution (lines per inch)	1000	
Scanning frequency (Hz)	250	400
Film speed (inches per sec)	.25	.4

The design of the scanning system permits a very compact output unit. Fig 3 shows a view of the complete machine which is about 4 feet high. The upper part is the output unit and the lower part contains the computer.

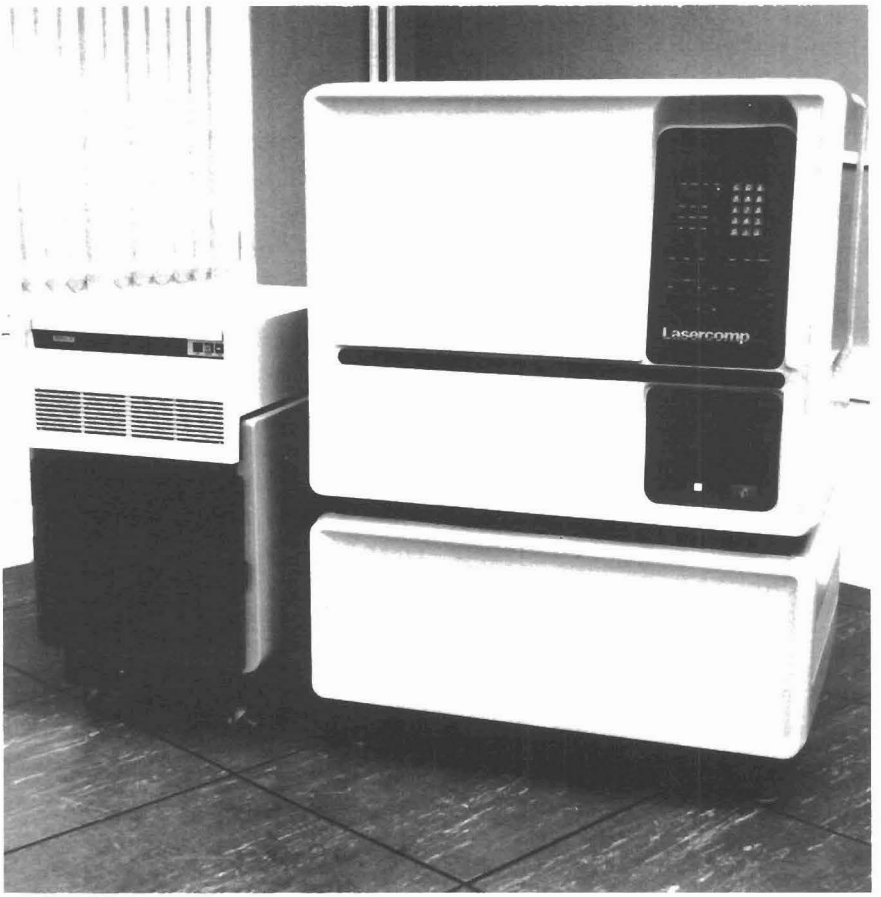


Fig 3 Monotype Lasercomp Mark 2 Photosetter

Drive Requirements

As we have seen the output unit permits any arbitrary image to be constructed from 1 mil dots or pixels across the full width of the scan and for an arbitrary depth. It is this which provides the enormous flexibility of a raster scan system, but which also places heavy demands on the computer system.

Fig 4 shows the way in which a line of characters is constructed. In contrast to the way in which a conventional CRT typesetter operates, drawing one complete character at a time, the laser typesetter must form each scan line across the page from the individual parts of each character that the scan line intersects.

Generating the characters

Since the page image is built up a scan line at a time, working from top to bottom of the page, all images on the page must be sorted into vertical order before output can start. There is no provision for reversing the direction of feed of the recording medium. Thus all 'reverse leading' instructions from the host system are processed into order by software in the image processing computer. Essentially this operates in two phases. The composition phase accepts quite conventional typesetter commands and generates a page file which contains a sorted list of images that make up the page. The output phase then uses this page file to access the digitised images, forming one scan line at a time for output to the laser recorder.

A further problem with raster output devices is that the scanning resolution is a fixed number of lines per inch. Thus to draw a character in different point sizes requires a different number of scan lines per character, making character sizing from a single master a non trivial task. Most CRT typesetters avoided this problem by using analogue scaling, varying the number of strokes per inch. Some CRT typesetters, notably the MGD MetroSet, performed true digital scaling by using a method of describing the shape of a character by its outline rather than as a series of scan lines. This approach is used in the Mergenthaler Omnitech laser typesetter, but is difficult to implement in a high speed typesetter. In any case automatic scaling from a single master involves aesthetic compromises in typographical quality, and the approach adopted in the Lasercomp is to hold individually sized characters. For users who consider the flexibility and economy of automatic sizing more important than the slight compromise involved a facility is provided for off-line sizing from a single master. This facility also permits expanded, condensed and rotated versions of typefaces to be produced.

Output Speed

The speed of a conventional phototypesetter is usually quoted in terms of characters per second or more usually 'newspaper lines' per minute. Depending on the exact characteristics of the machine its speed will vary with point size and measure and be reduced by changes in font, but broadly speaking its speed will be much the same whether it is setting narrow galleys or whole pages.

In contrast, as we have seen, the output unit of a raster scan typesetter exposes a certain number of scan lines per second and thus a certain area of film per second. The number of characters that can be

output is highly dependent both on the size and the measure that are in use. Thus setting a single galley is very wasteful and the full efficiency is only reached when using the whole measure of the machine. The new generation of raster scan output devices should therefore be regarded as page output devices.

Comparison with CRT

Laser phototypesetters have some advantages over their CRT predecessors that are a direct result of using lasers rather than CRT's, and some which are a consequence of the raster scan technique rather than the light source employed.

Quality is a very subjective matter, and indeed there are several aspects to quality in a phototypesetter. The typographical appearance is, of course a matter of the quality of fonts provided by the manufacturer. Character fit and alignment are dependent both on the quality of typographical design and the accuracy of the typesetter. Image sharpness is principally determined by the output unit. The laser beam provides a well controlled spot without halation giving very good image definition. Whilst important for text this is still more important for half tone dot reproduction. The raster scan output unit as used in the Lasercomp provides excellent accuracy of fit and alignment.

The use of CRT's for wide measure phototypesetters is difficult and expensive. Where an imaging lens is used this must provide a higher magnification resulting in a degradation of quality. Where fibre optics are used there are greater problems in obtaining large enough tubes of adequate quality and in correcting tube nonliinearitities. The scanning laser beam suffers from neither of these problems, making a wide measure optical unit very little more expensive than a narrower one.

As was seen earlier the laser output unit is mechanically very simple and so is very reliable. The helium neon laser has a longer life and provides lower operating costs than a CRT.

The most significant advantage of laser typesetting is the inherent flexibility of the raster scan system. This has been exploited in the following ways:

1. Special effects
   positive/negative, reverse/direct, reverses
2. Geometrical shapes
   boxes, diagonals, ellipses, patterns
3. Pictures
   line graphics, half tones.

Special Effects

Because the laser beam sweeps across the full width of the output medium it is a simple matter to invert the driving signal to create a negative image or to reverse the order in which the data is supplied to create a reverse reading image. Thus the Lasercomp can, at the flick of a switch, produce reverse reading negative film, saving the extra step involved in making a film negative from a paper positive for platemaking.

Under software control the data inversion can be selective permitting reverse type to be produced (see Fig 5 for example). Effectively the laser beam is able to write in white as well as black! In contrast to the similar effect provided on some CRT typesetters there are no restrictions involving overlapping or kerning characters.

Fig 5 Lasercomp Special Effects

Geometrical Shapes

To aid in the production of display ads and business forms, facilities have been provided to generate various geometrical shapes from simple typesetter commands. The basic 'primitive' shapes provided include (a) rectangle, (b) rectangle with selected corners rounded with ellipses (c) elliptical corner piece (d) slanting rule. From these primitives the host system can generate more complex structures as can be seen in Fig 5.

As well as being produced in normal (black) or inverse (white) mode these geometrical shapes can also be patterned. Six different pattern types are available and the proportions of black and white for each pattern can be varied. Again this pattern mode is controlled by simple commands from the host system. Fig 5 shows some of the effects that can be obtained.

Pictures

The geometrical shapes are computed by the image generating computer system. The other main class of graphic image is pictures which are digitized and held on the disc store of the image computer. Two different types of picture are catered for - line graphics and half tones. These are stored and output in quite different ways.

Line graphics are digitised at the full output resolution (1000 lpi.). Essentially the data that is stored represents a value of 0 (white) or 1 (black) at every output point, although the actual volume of data stored is greatly reduced by simple run-length compression. Storage and output of line graphics are quite similar to the techniques used for characters.

Half tones are handled in a very different way. An original photograph is digitised as a continuous tone picture. The picture is sampled at a resolution

Newstec

MONOTYPE MAIL

Brighton, England, November 1981

Lasercomp Mark 2 - the first UK showing at Newstec '81

The Image Setter for the future

Following a highly successful debut at the recent IFRA-Expo in Lausanne, the 'Monotype', 'Lasercomp' Mark 2 will be seen publically for the first time in the UK at Newstec '81 in Brighton.

'Lasercomp' Mark 1 was launched at the 1976 Newstec exhibition and heralded a new era in phototypesetting by using a laser beam as a light source and scanning in a horizontal mode. Since then, other manufacturers, acknowledging the vast potential offered by laser technology, have entered the field but still have to achieve proven versatility of the already commercially accepted 'Lasercomp'.

The 'Lasercomp' Mark 2 Image Setter incorporates all the developments in new facilities and system enhancements that have taken place since 1976.

The Mark 2, more compact and with new styling, offers in addition to high speed typesetting and traditional Monotype quality, a comprehensive range of capabilities including

Rule and business forms
Line and half tone illustrations
Full page make up of text and graphics
Tints, patterns and logos
Fount sizing

The Mark 2 is now available in 68 pica, 100 pica and 108 pica width versions to meet the widest range of customers' requirements. The 68 pica version for example, can set a tabloid newspaper 80 per cent faster than a 100 pica Mark 1.

Basic UK prices for the models are (in pounds)

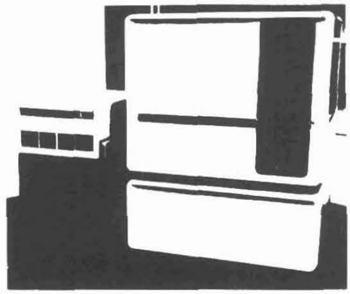
68 pica	38,000	*The basic price for a*
100 pica	41,000	*Mark 1 58 pica machine*
108 pica	47,000	*was 40,000 pounds*

The new model, like the original, can be driven by any front end system.

Orders already received from the UK and overseas for the Mark 2 already exceed 250,000 pounds.

OVER 150 'LASERCOMP' INSTALLATIONS WORLDWIDE:

Algeria	Germany	Lebanon
Australia	Holland	Poland
Austria	Hong Kong	South Africa
Belgium	Hungary	Spain
Bulgaria	India	Switzerland
China	Iraq	Tunisia
Egypt	Ireland	Turkey
Finland	Italy	United Kingdom
France	Japan	United States



The new contemporary styling of the 'Lasercomp' Mark 2

DESIGNED FOR THE LATEST NEWSPAPER TECHNOLOGY

Nimrod

by ROBIN NICHOLAS, with normal and bold weights with italics.

In this new digitised typeface the unique 'Monotype' experience in type design and manufacture has been combined with the newer, but well-practised 'Monotype' skills required to make successful digitised founts.

Robin Nicholas

Robin Nicholas of the Monotype Type Drawing Office, the designer of Nimrod, made a thorough study of contemporary newspapers and many other types, and among the mass of detail considered were the robust features of several well proven 'Monotype' faces such as Ionic, Century Schoolbook and Monotype Plantin.

Greatest exotic language triumph for 'Monotype'

نوری نستعلیق "لیسر کامپ" کے ذریعہ۔
زبانوں کے سلسلہ میں "مونوٹائپ" کاایک عظیم شاہ کار

URDU NASTALIQ

SPECTRON 2

from MONOTYPE - introducing phototypesetting with a difference

Now the new Spectron 2 from Monotype is better than ever, not only for display adverts, but also for all those awkward jobs like sports tables, head lines, public notices, etc., etc. or so our critics tell us.

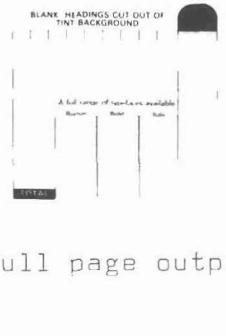
FRONT END SYSTEMS

TYPES OF WORK

Newspapers	Trade
Magazines	Typesetting
Directories	Commercial
Bookwork	Yellow Pages
Mathematics	Calendars
Timetables	Scientific
Forms	Research and
Cheques	Development
Arabic	Parts Lists
Texts	Chinese
	Ideographics

Digitised halftones from 'Lasercomp'

Forms-Master!



The Monotype Recorder New Series, Number 3 now available

STOP PRESS

Output on Lasercomp in under 2 minutes !

Fig 6 Full page output

corresponding to the final output screen ruling. Each sample point is held as a grey level value between 0 (white) and 255 (black).

On output halftone dot patterns are generated within the typesetter in accordance with the grey levels. This process may be thought of as using a special halftone dot font with one character for each grey level. The actual implementation is rather more efficient than this, eliminating the overhead that would be involved in handling each dot as a character, but the result is much the same.

This continuous tone representation of photographs provides considerable advantages over the alternative of handling screened pictures as line graphics. First the contone representation provides considerable data compression. Second, and more important, it provides a high degree of flexibility. It is a simple matter to manipulate the tone range to accommodate differences in printing requirements and variations in original material. Although facilities for scaling pictures on output are not provided the contone technique will permit scaling to be performed using interpolation. Screened line art can only be scaled with a variation in the resultant screen ruling.

Generation of pictures on a laser typesetter can be much faster than with a conventional CRT device. Provided the image generation computer is capable of maintaining the flow of data the raster output device exposes a constant area of film per unit time, no matter what is being output. In contrast the CRT beam is not normally sweeping over the white space between characters and the speed of operation falls considerably when it is exposing large contiguous areas of graphics.

Fig 7. 65 line Lasercomp half tone output

Our work with pictures has mostly used the ECRM Autokon as an input scanner. The Autokon is also a raster scan laser device. It was developed originally as a stand alone electronic process camera with both read and write laser systems. A computer interface has been developed permitting use of the read part of the machine as a graphics input device. The Autokon uses a clever combination of digital and analogue electronics to provide great flexibility. It can be used to scale anamorphically and provides facilities for tone range adjustment and edge enhancement. Our use of the Autokon makes the best possible use of these features.

Extensive experimental work is under way on the production of half tones using the Lasercomp. This is concentrating on achieving good reproduction with different screen rulings and different print processes. Screen rulings of 65, 85 and 100 lines per inch are available. The main variables are the sizes of the end point dots, the tone reproduction curve between, and the screen dot shape. Although it is too early to report in detail the results are encouraging, and print samples are being obtained that are comparable to those obtained by conventional camera processes.

System use.

The typesetter is really just a peripheral to a complete typesetting system - essentially it is a rather special line printer. To fully utilise the facilities that have been described it must be driven by a computer system which provides facilities for input of text and pictures, file management and page layout. The components of such a system are shown schematically in Fig 8. The front end module provides facilities for text capture and correction. Pictures are input to the scanner sub system and transferred to the data base maintained by the file manager. The

page make up module formats text and pictures into a page layout. When this is complete the typesetter commands for the page are transmitted to the output device together with the digitised picture data required for the page.

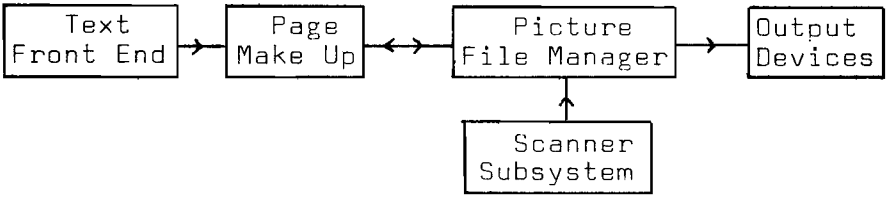


Fig 8 Page Production System

The actual implementation and configuration of such a system would depend on the application. Factors such as graphic content, production volumes, archiving requirements and redundancy would determine the arrangement of computers used, and the amount and type of storage provided. Fig 9 shows the configuration of a system which is in use for setting yellow page telephone directories.

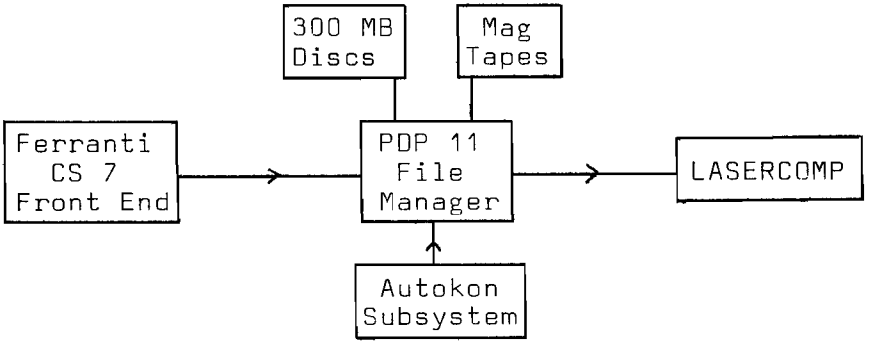


Fig 9 Yellow Page System

The fact that all information required for each page is transmitted digitally offers the possibility of remote typesetting as an alternative to conventional facsimile for remote printing applications. Remote typesetting effectively provides a very efficient form of data compression since each character on the page is transmitted as one byte of data rather than many bits of facsimile scanned data. The compression obtained with graphics is not as good as with text but nevertheless is comparable with that achieved by sophisticated data compression techniques, and there is considerable scope for improvement. As well as reduced bandwidth and hence reduced transmission costs remote typesetting provides better output quality, since the degradation in quality caused by scanning before transmission is eliminated. Remote publishing by this data communications approach also provides considerably greater flexibility. This technique has been used before by Information International Inc in applications such as the US News and will certainly find wider application.

Future potential.

As has been seen laser typesetters such as the Lasercomp offer the ability to image complete pages including text, special effects and pictures. Such devices can only really be exploited properly as part of a system which provides comprehensive layout facilities. Considerable progress is being made in the area of page make up, so that the facilities provided by the make up system match those of the output device and vice versa.

As these problems are solved the next logical step forward is direct plate exposure. A number of factors, technical and economic, will influence progress in this direction. Technically it would seem difficult to expose the large signatures required for much commercial printing, but newspapers and applications

such as forms seem more promising. Direct plate exposure has been technically feasible for some time by combining the image generation part of the typesetter with the laser scanner part of a laser platemaker. Developments in plate materials should help to make this more attractive economically.

The laser scanning and raster image generation technologies described clearly have applications outside the narrow area of 'typesetting'. Similar techniques are employed in so called 'intelligent copiers' and there are applications outside the publishing field such as the exposure of printed circuit boards. Laser typesetting is just one application of these rapidly advancing technologies.